POLARIMETRIC L-BAND PALSAR FOR PEATLAND CHARACTERIZATION

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ABSTRACT

Canada has 25 % of the world's wetlands and wetland management has become a critical issue in order to avoid or mitigate further loss of wetland area or function. Peatlands represent an important wetland class very sensitive to climate change. While it is well established that fens change naturally into bogs over time and that bogs can revert to fens, the observations over the last fifty years indicate that the rate of these changes has been significantly altered by climate change, isostatic uplift, fire, and goose grazing. This has been noted in the Hudson Bay Lowlands, which contains the most extensive wetlands and thickest peat deposits in Canada [1-3]. The region is home to unique concentrations of wildlife, most notably polar bears, caribou, and migratory birds. Bears rely on inland denning habitat, caribou are tied to peatland vegetation, and birds intensively graze coastal herbaceous salt marsh and fen. The loss of bogs will have important implications for polar bear denning habitat which is entirely within bogs with thick peat deposits [1-3].. Earth observation satellite and in particular all weather L-band polarimetric ALOS, should provide the required information for monitoring the impact of climate change on the integrity of peatlands in the Northern of Canada.

Two peatlands sites are considered in our investigation; Lac St Pierre (North of Montréal) and the Wapusk National Park in the Hudson Bay Lowlands of Manitoba. Two polarimetric ALOS acquisitions took place on Lac St Pierre at spring and fall seasons (May and Nov 2007), during the calibration phase. Unfortunately, we were not lucky with the Wapusk site, and only acquisitions achieved at saturated water conditions are available because of the limitation of polarimetric window acquisitions.

In this study, the Touzi decomposition [4], which has been recently introduced for a unique and roll-invariant characterization of target scattering, is investigated for peatland characterization. In contrast to the Cloude-Pottier [5] decomposition, which uses a real entity to describe target scattering type, the Touzi decomposition characterizes uniquely the scattering type with a complex entity, whose both magnitude and phase have been shown very promising for wetland class characterization [6, 7]. In particular, the new target scattering phase has been shown to be very promising for separation of nutrient poor fens from bogs.

The results obtained with L-band PALSAR on Lac St Pierre confirm the excellent performance of the Touzi scattering phase. for detection of underneath peat water flow.
While the scattering phase could detect the peat beneath water level change, the polarization radiometric scattering information (provided by the Cloude α, the entropy H, and the multi-polarization (HH, HV, and VV)) is insensitive to the presence of underneath peat water, as seen in Figure 1-4. The Touzi phase can detect the presence of water flow beneath peat surface in bogs of thin peat (up to 1.4 m) . However, the phase looks to be less sensitive to deep water in thick bogs (more than 2.8 m). As such, the phase looks very promising for providing information related to the peat thickness, and we would expect that this parameter should play a key role in monitoring the bog-fen transformation process related to climate change stress.

Unfortunately, the results above could not be confirmed with the Wapusk data sets collected under water and ice saturated conditions (June 2007). The phase is no more efficient under saturated water conditions, and only the polarization radiometric scattering information can be exploited. Like HV, the polarimetric scattering type permits detecting of the presence of water in swamps or treed bogs, but no useful information can be retrieved related to the presence of water underneath the peat. We would expect much better results with acquisitions that would be completed during summer dry conditions. We wish that JAXA will allow us to have a series of 45 days polarimetric acquistions collected between June and September.

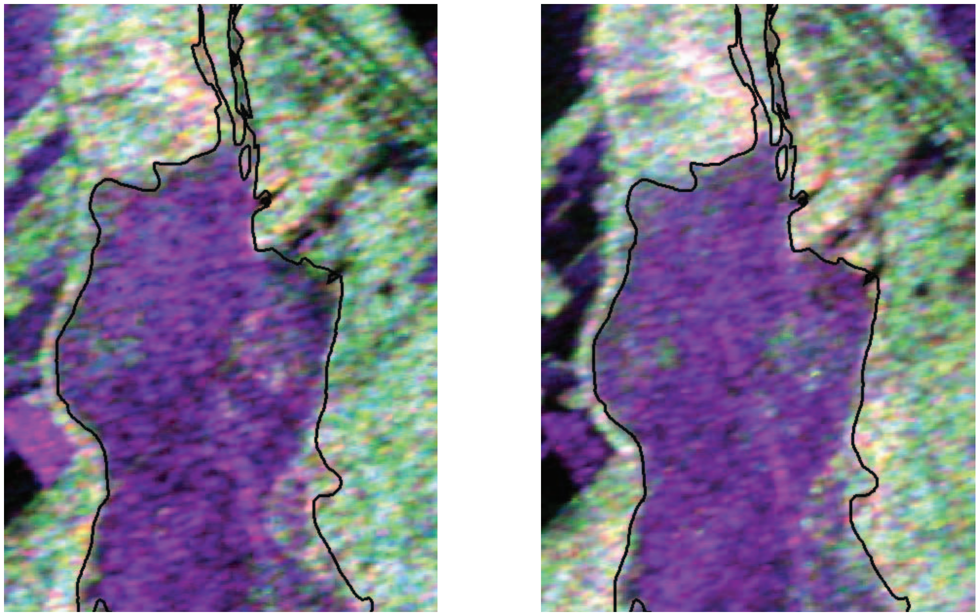

Fig. 1 HH-HV-VV May 07 Nov. 07

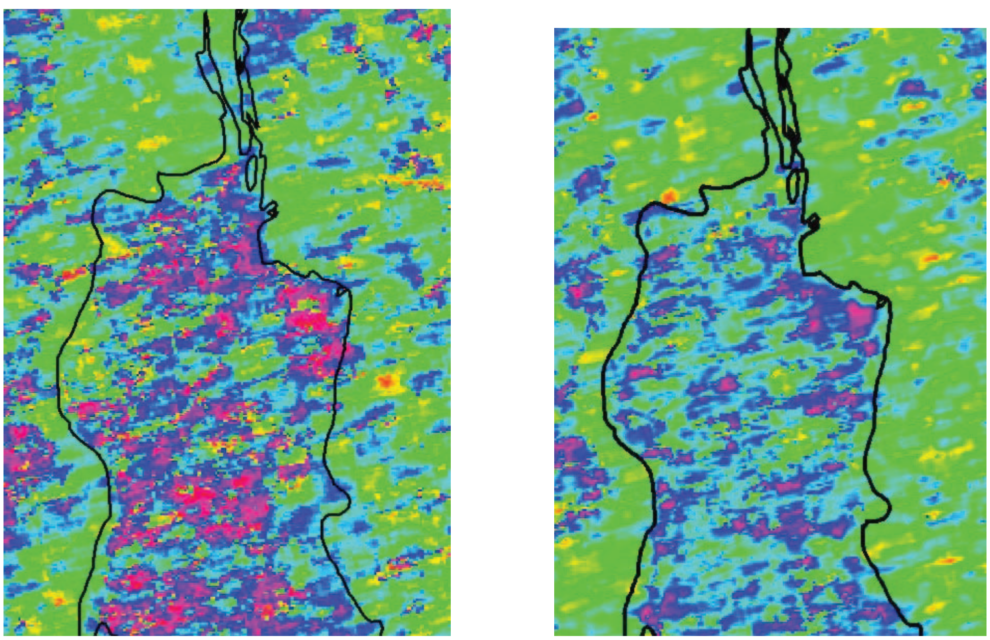

Fig. 2 Touzi-Phase May 07 Nov. 07

Dark blue correspond to thick peat, whereas pink colour indicates shallower bog beneath water. No underneath water flow change is detected with HH-HV-VV.

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